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camphors differ only quantitatively in action. "Apparatus for Recording the Outflow of Liquids," by W. R. Williams. The mechanical description of an efficient method of recording secretions in physiological work.

RECENT PROGRESS IN METEOROLOGY AND CLIMATOLOGY

THAT interest in meteorology and climatology is increasing is shown by the advancement made within recent years, in the instruction offered in these fields by American colleges and universities. A comparatively few years ago only a few of the larger eastern universities included such courses among their sciences. At the present time, however, nearly every institution of note offers such electives, while in most agricultural schools these studies are included in the prescribed work. In some institutions, such as the Universities of Iowa and of Wisconsin, the courses are included in the work offered by the department of physics, while in others, notably Harvard and the University of Minnesota, they come under the supervision of the department of geology. A typical example of the rapid growth of interest in these sciences from an educational point of view is seen in the history of the courses in the last named institution. The first course in meteorology at the University of Minnesota was given by Professor C. W. Hall, head of the department of geology, in the spring term of the year 1906-7. This was a half-year course in elementary meteorology and the class numbered ten students, all of whom were juniors or seniors in the academic college. The numbers have grown and the interest has increased to such an extent that during the present school year a course covering one year, and including climatology, has been instituted by Professor E. M. Lehnerts, of the same department, who now has charge of the work. The class in the latter course now numbers seventy-six, of whom forty-seven are juniors and seniors in the academic department, and twenty-nine are freshmen and sophomores in forestry and agriculture.

THE last number of the United States Weather Bureau's *Monthly Weather Review*

in its accustomed form has recently been issued. As announced by Professor Willis L. Moore, the chief of the bureau, on March 12 last, the *Weather Review* will hereafter be "a monthly report of the weather and climatology of the country, and there will be excluded from its pages everything technical that is not of a purely climatological nature or a current report of weather conditions." While the change was doubtless made after careful deliberation, it is a change that students of meteorology will regret nevertheless, as it leaves the United States without a single meteorological journal of any kind. Although various American journals contain notes from time to time in meteorology and climatology, no magazine is devoted exclusively to these sciences, as are several in Europe. With our extensive weather service and with the increased interest in these fields within recent years, it would seem that the time is now ripe for the institution of a new journal as a private enterprise. Indeed, it is not improbable that the deceased *American Meteorological Journal* would meet with a hearty welcome if it should be resurrected.

Senór V. Castaneda, of the Mexican Weather Service, recently visited the United States for the purpose of studying the methods of distributing weather forecasts, storm warnings and the like, and also of the carrying on of other routine matters of a meteorological service. He spent part of September in the central office of the United States Weather Bureau in Washington, and then visited other stations of the bureau, going as far north as Boston, where he visited the Blue Hill Observatory. He is the second representative of the Mexican bureau to visit this country in such a capacity—the head of the service, Senór Manuel E. Pastrana, having been here for a considerable period three years ago. The object of his mission was to study the scientific basis of weather forecasting and the acquiring of the data from which the forecasts are made. The Mexican Weather Service has done some very creditable work, aside from the daily routine, the most important probably having been the preparation of a cloud

atlas which is now in the hands of the publisher. The bureau is also unique in that it is probably the only national service which attempts to forecast the weather for one month in advance. This feat is rendered somewhat simple, however, by the uniform character of the climate of Mexico.

THE weather service of Argentina under the direction of its chief, Mr. Walter G. Davis, a native of the United States, has expanded considerably within the past year. At present the stations at which simultaneous meteorological observations are made and communicated to the central office in Buenos Ayres form a network which covers all of the republic. Aside from this a beginning has been made toward the carrying on of research work. Mr. George O. Wiggin, the subdirector, also a native of the United States, recently was sent to this country for the double purpose of engaging a number of capable men to enter the service, and also to study the methods of investigating the upper atmosphere as practised by the Blue Hill Observatory and by the Mount Weather Observatory. He spent several weeks at each place, as did also several of the men whom he had obtained to assist in this work when it is begun in Argentina. Mr. S. P. Fergusson, of the former observatory, is now preparing a complete set of kite-flying apparatus for this part of the research work. When this equipment reaches its destination it is the hope of the director to have daily kite flights, similar to those now being carried on at Mount Weather. Such real progress must indeed be gratifying to all interested in the advancement of meteorology.

DURING the week beginning December 6, kites and balloons have been sent up simultaneously, for meteorological purposes, from about forty selected stations scattered throughout the world, including two in the United States—the Mount Weather Observatory and the Blue Hill Observatory. After the results obtained have been computed, they will be sent to the International Commission for Scientific Aeronautics in Strassburg, Germany, and it is expected that much will be learned from them concerning the movements

of the upper atmosphere and their relation to conditions at the earth's surface. At the Mount Weather Observatory the work consisted of the usual daily kite flights, as no sounding balloon experiments were possible on account of a delayed consignment of balloons from abroad. At the Blue Hill Observatory pilot balloons were used on Monday and Tuesday, while sounding balloons were sent up from Pittsfield, Mass., under the personal direction of Professor A. Lawrence Rotch, the director of the observatory, on Friday, Saturday and Sunday. The pilot balloons are made of rubber and when filled with hydrogen gas expand to a diameter of about 75 cm. When one of these is liberated its altitude in degrees, together with its azimuth, are observed simultaneously, at the end of each minute, by means of transit instruments placed about a mile apart. From these observations the velocity and direction of the wind for all heights reached by the balloon while it remains visible, can be calculated. Occasionally such a balloon can be seen at both stations for over an hour, and the heights known to have been reached have exceeded ten miles in several instances. As no recording apparatus is attached to it, no attempt is made to recover the balloon, which either rises to a height where it bursts, due to the increased expansion as it rises, or is carried by the prevailing westerly winds aloft far out to sea. The sounding balloons, also made of rubber, are somewhat larger, being about 200 cm. in diameter when expanded, and carry a meteorograph which records the temperature and pressure of the air for all heights reached. They also carry a parachute, which, after the balloon bursts, brings the instrument safely to the ground. The basket covering the instrument bears a message to the finder asking him to return the apparatus intact to the Observatory, for which service he receives the sum of two dollars. Of the three balloons sent up from Pittsfield in the international series, only one of the recording instruments had been returned up to the time of this writing (January 1).

IN the investigation of the upper atmosphere Germany has always been the most ac-

tive, and the experiments carried on in this field by its scientific institutions continue to be an example for other nations to follow. Not only are daily kite flights made and pilot and sounding balloons sent up from a number of well-scattered stations in Germany, but expeditions to carry on similar work have frequently been sent to far distant lands. One such expedition only recently returned from a long and successful visit to equatorial Africa. During the recent international series of simultaneous upper air investigations, five such expeditions carried on these experiments in foreign countries. One of the latter, stationed in the Danish West Indies, carried on its work under the personal supervision of Professor H. Hergesell, one of the founders of, and still a leader in, aerial investigation. Frequently on these expeditions the sounding balloons are sent up from a ship out in a large body of water. The balloons are followed by the ship until they burst, and when the parachute brings the apparatus back to the water surface the instrument and records are immediately recovered.

WHILE polar exploration generally is not primarily for meteorological purposes, the data obtained often contribute greatly to our knowledge of atmospheric conditions in these parts of the earth. It might be said that next to the accounts of previously unvisited lands the meteorological data obtained on these expeditions probably form the most valuable information. Especially important are these data when they contribute information concerning the planetary winds and pressures. Temperature data, while very interesting, are not so important. That the polar regions offer exceptional opportunities for meteorological research is recognized by Count Zeppelin, who is making plans to explore the entire north polar region by means of an airship. In this formidable plan the idea of reaching the pole is only incidental, the enterprise in this case being primarily meteorological. A new British Antarctic expedition is also being organized by Captain R. Scott, the leader of the expedition in the *Discovery*. The meteorological observations obtained in this expedition,

which is to begin the coming summer, will undoubtedly add greatly to our knowledge of Antarctic conditions.

THE relation between meteorology and aeronautics is so close that one does not advance without having a similar effect upon the other. While it is true that the former science has not advanced so rapidly during the last two years as has the latter, its advancement has undoubtedly been accelerated by the great progress made in the science of navigating the air. The close union of the two is seen in the following list of names of men prominent in both fields: Hergesell, Zeppelin, Süring, Berson, Rotch, Clayton and Hersey. The men who are really the cause of the recent progress in aeronautics have frequently found it profitable to consult meteorological authorities as to the atmospheric conditions with which an airship has to contend. Moreover, Wilbur Wright, in a recent interview is reported to have said that the progress of the next two years in the art of flying will be largely progress in manipulation and navigation, not in construction, as the past two years have been. In other words, it was his opinion that progress in the immediate future would be in the controlling of the air craft in various atmospheric conditions, rather than in the details of construction—a prophecy which clearly shows the cause of the close relation between the two sciences. Again, Hubert Latham, the well-known foreign aviator, who for a time held the record for height attained by an aeroplane, is quoted as saying that it is easier to navigate the air at moderately great heights than at low heights, because of the steadier, though stronger winds aloft, the varying winds near the surface being as dangerous for an aeroplane as the waves and eddies in the water near a coast are for a ship. A knowledge of such characteristics of the atmosphere is thus of importance in both sciences.

DURING the past year the United States Weather Bureau has, from time to time, issued a long-range forecast of the weather for the whole of the United States—one forecasting the weather conditions expected for the follow-

ing seven days. Considering the difficulty of the problem, the forecasts have been remarkably successful. While the percentage of accuracy of these forecasts has naturally not been so great as the high standard reached and maintained by the daily forecasts, a good beginning has been made. Doubtless the researches carried on at Mount Weather, especially the upper-air investigation, are already beginning to bear fruit. Meteorological research under the auspices of the United States Weather Bureau is still in its infancy, and no one can tell what may be learned when it has progressed a few years longer. The upper-air investigation gives promise of most desirable results. The daily kite flights under the direction of Dr. William R. Blair have been very successful, the average height obtained being great, while the world's record for height reached by a kite is still held. Since in these experiments the data obtained include temperatures only, it is to be hoped that the other meteorological conditions at the kite may also be obtained. Sounding-balloon experiments have been instituted with fair success by the bureau during the past summer, Omaha and Indianapolis having been selected for the work on account of their central location. It is probable that more of this valuable work will be carried on during the coming year.

As to what may be accomplished for meteorology by men who are thoroughly interested in the science, the history of the Mount Rose Weather Observatory is a striking example. The history of this project is the history of the zeal of a professor of Latin, Professor J. E. Church, Jr., of the University of Nevada, and that of a few of his colleagues whom he interested in the work. The observatory is an automatic one, located upon the summit of Mount Rose, a mountain 10,800 feet in altitude, situated sixteen miles southwest of Reno, Nevada. Begun in 1905, when maximum and minimum thermometers were placed there to obtain further data on summit temperatures in the Sierra Nevada in winter, it was discovered soon afterward that "frost forecasts could be made with considerable certainty

from the mountain top in advance of instrumental indications below." This discovery led the Nevada Agricultural Experiment Station in June of the following year "to offer a provisional appropriation of \$500 under the Adams Act to supplement the independent effort of the faculty of the university." Following this the work formally became and has continued to be the department of meteorology and climatology of the Nevada Agricultural Experiment Station, with Dr. Church the co-operative observer. Owing to the extremely hazardous transportation, the work of construction proceeded with difficulty, but before the advent of winter the building was completed and some instruments installed. Of the latter the most interesting was a precipitation tank thirty inches in diameter and four feet high with an intake pipe eight inches in diameter and thirty feet long. This instrument was of great value in ascertaining the total amount of snow falling during the winter season, making it possible to estimate the probable amount of water available for irrigation purposes during the following summer. Considering the inaccessibility of the observatory, the records obtained have been fairly complete and are extremely interesting. The instrumental difficulties encountered are summed up by Dr. Church in his last report in which he says: "The perfecting of an automatic meteorograph which will successfully record the weather conditions at high altitudes is the necessary antecedent to a more thorough knowledge of mountain meteorology, and it is at present the most important problem of the observatory." To overcome this problem, Mr. S. P. Fergusson, of the Blue Hill Observatory, who designed and constructed the meteorograph placed by Harvard on El Misti, Peru, was engaged to build a somewhat similar one for the Mount Rose Station. This was completed in due time and, after having been tested at the University of Nevada, it was permanently installed upon the summit of the mountain. While progress was handicapped awaiting the completion and installation of the necessary apparatus, investigations were carried on based upon the records already obtained on

the mountain. Of these the more important were the general climatology of Mount Rose, the relation of climate to the plant environment, the relation of timber to the conservation of snow, and the frost forecasting from the summit. With such a record for its short life, and with ambitious plans for the future, progress is certain to be the result. Having recently been assured of further support by the office of experiment stations of the national government, the zealous workers are almost certain to produce results which will be of great value to meteorology in general and to the agricultural interests of the Great Basin in particular.

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CONCERNING THE DATE OF THE LAMARCK MANUSCRIPT AT HARVARD

A CURIOUS mistake has found its way into M. Landrieu's "Life of Lamarck" regarding the probable date of the Harvard manuscript to which I referred in the March number of the *American Naturalist*. In this article I had stated that the "Manuscripts de Lamarck" were "*brought together* in a volume, the binding dating 1830-40," and that in this little volume there was "a table of contents, probably in the hand of the *early owner* [this does not mean the *author*] of the manuscript." Also that "it will be noted that the papers were *collected* before 1835, the year of the appearance of the second edition of the '*Animaux sans Vertèbres*,'" because in the table of contents, referred to above as "in the hand of the *early owner*" "it is stated that the drawings *will form* part of the second edition" of that work.

Now M. Landrieu remarks in perfect seriousness that I have given the probable date of the *writing* of the manuscript "as before 1835," at which time, as he notes, "Lamarck had been dead six years, after ten years of total blindness!" So I must now smilingly protest that I was aware of the date of Lamarck's death, and even when his eyesight failed him—in fact I mentioned the latter

date, as 1818, in the same *Naturalist* paper (p. 148) which my colleague has so imperfectly read. The year 1835 is but a landmark in the Harvard manuscript, since it was at that time or somewhat before that time that its five component parts were brought together in a little volume by the "*early owner*," who may well have been an editor of the second edition of the "*Animaux sans Vertèbres*." If, moreover, my good friend M. Landrieu had interpreted the *Naturalist* paper carefully, he might have discovered that I have given the probable dates of various parts of the Harvard manuscript as prior to 1818, "the year in which Lamarck's eyes failed him." So, after all, M. Landrieu's estimate of the date of these manuscripts and my own do not differ widely. He gives the dates between 1810 and 1820—thus he is even less conservative than myself, for he assumes that Lamarck may have continued to write his papers *propria manu* even after his eyesight failed.

BASHFORD DEAN

SPECIAL ARTICLES

THE INTERFERENCE OF THE REFLECTED DIFFRACTED AND THE DIFFRACTED REFLECTED RAYS OF A PLANE TRANSPARENT GRATING, AND ON AN INTERFEROMETER

If parallel light, falling on the front face of a transparent plane grating, is observed through a telescope after reflection from a rear parallel face the spectrum is frequently found to be intersected by strong vertical interference bands. Almost any type of grating will suffice, including the admirable replicas now available, like those of Mr. Ives. In the latter case one would be inclined to refer the phenomenon to the film and give it no further consideration. On closer inspection, however, it appears that the strongest fringes certainly have a different origin and depend essentially on the reflecting face behind the grating. If, for instance, this face is blurred by attaching a piece of rough wet paper, or by pasting the face of a prism upon it with water, so as to remove most of the reflected light, the fringes all but disappear. If a metal mirror is forced against the rear